The Persuasive Edge of Design: Content Experience as a Mediator and Demographics as Moderators of Persuasion in DOOH Advertising

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ABSTRACT

Despite the rapid commercial expansion of emerging markets, academic research remains limited on how digital signage design and content influence persuasion across demographic groups. This study examines the interplay between signage design, content experience, and consumer demographics in contributing to persuasive outcomes in digital out-of-home retail advertising. Drawing on the Stimulus–Organism–Response framework, a structured survey of 350 consumers in an upscale South African mall was conducted to test a model in which signage design influences persuasion both directly and indirectly through content experience. Results indicate that design has a significant predictive effect on persuasion, whereas content experience does not mediate this relationship. Demographic traits are instrumental; income and gender moderate several key relationships within the model, suggesting that design and content vary by demographic profile. These findings highlight strategic opportunities for customising digital media in diverse and demographically segmented markets. The study advances the understanding of digital out-of-home effectiveness in South Africa, a context in which digital signage is expanding rapidly yet remains underexplored. Simultaneously, the findings hold broader relevance as core cognitive and behavioural mechanisms—especially those captured by the bottom-up versus top-down attention model—offer valuable insight into how signage design captures attention and drives persuasion across different global markets. This study provides practical recommendations for designing and implementing digital signage, which functions effectively both visually and psychologically within real-world retail environments. It advocates for demographically informed, strategically designed signage that aligns with how shoppers perceive, process, and make purchasing decisions.

Keywords: digital out-of-home advertising, media design, content experience, consumer demographics, persuasion, bottom-up versus top-down attention, retail advertising, emerging markets

The Retail and Marketing Review

Volume 21, Issue 2, November 2025, Pages 106-124

Doi: https://doi.org/10.5281/zenodo.17341624

1. INTRODUCTION

The expansion of the international Out-of-Home (OOH) advertising sector is primarily driven by technological advancements and the accelerated deployment of digital screens across both developed and emerging economies. OOH media is defined as “commercially available and physically rentable assets situated outside the home in both public and commercial places” (Wilson 2022, p. 279). To clarify the conceptual scope, scholars often define digital signage as location-based networks that deliver dynamic advertising and editorial content within indoor environments (e.g., Burke 2009; Dennis et al. 2010, 2012; Wilson 2022). In contrast, digital out-of-home (DOOH) media extends beyond indoor spaces to include digital screens in public and high-traffic areas (e.g., Roberts 2018; Roux 2018; Taylor 2015). This study conceptualises digital signage as a subset of DOOH media, focusing on interactive displays in upscale retail malls. These digital screens deliver real-time, context-sensitive content, including advertising, news, community updates, and entertainment, and can be configured to enhance consumer engagement through interactivity (Roux 2024).

Within the broader OOH advertising category, DOOH has emerged as a significant area of global expansion (Grandview Research 2024), gaining increased visibility in emerging economies across the African continent (Myburgh and Stuart 2019; Statista 2024). Although DOOH has experienced rapid commercial growth, academic research remains limited, highlighting a gap in knowledge of how diverse demographics intersect with digital signage, particularly in upscale mall environments (Dennis et al. 2010, 2012; Roux & Maree 2021; Roux et al. 2020). Consequently, there is a growing need for research into content-relevant advertising, as the effectiveness of persuasive messaging depends on its timeliness and relevance (Canguende-Valentim & Vale 2022; Potgieter & Roux 2024), as well as consumers’ ability to cognitively process DOOH advertising as it expands into emerging markets (Wilson 2022).

While commercial DOOH continues to grow, academic research has focused predominantly on consumer responses to different content formats within retail contexts (Bae et al. 2016; Burke 2009; Dennis et al. 2013; Dennis et al. 2014; Garaus et al. 2021; Nanni and Ordanini 2024; Roggeveen et al. 2016; Willems et al. 2017), malls (Dennis et al. 2010, 2012; Roux and Maree, 2021; Roux et al. 2020), and public spaces (Bauer et al. 2011; Lee & Cho 2019).

By contrast, the role of design as a persuasive factor has received far less attention than content in DOOH research. Digital signage design involves the strategic placement of displays to maximise engagement, with variables such as location, human density, screen design, and visual salience all shaping effectiveness (Xaba et al. 2020). Furthermore, digital signage is particularly critical in multicultural, high-traffic environments, where differences in language, cultural references, and media literacy require consumers to rapidly decode visual cues and distinguish between advertising and ambient content.

Nevertheless, most research treats content and media design as separate elements rather than examining their relationship. Understanding how these bottom-up features operate individually and in combination is essential for advertisers seeking to sustain engagement in retail settings. Equally underexplored is the interaction between visual features and "top-down" influences such as demographic traits and content experience. Demographics encompasses the cultural, linguistic, and socio-economic diversity of consumer groups, which shape how messages are perceived and processed (Potgieter & Roux 2024). Within DOOH contexts, these demographic factors influence the extent to which design and content resonate with distinct audience segments.

This study addresses these research gaps by investigating how digital signage design, content experience, and demographic complexity mutually contribute to persuasive DOOH contexts. This research draws on the Stimulus–

Organism–Response (SOR) framework, where signage design serves as the stimulus, content experience corresponds to the organismic process, and persuasion denotes the behavioural response. Demographic variables are treated as moderators that mediate the dynamics of these relationships.

In doing so, this study expands on earlier research focusing on digital content and its influence in retail, mall, and public environments (e.g., Bae et al. 2016; Burke 2009; Dennis et al. 2010; Roggeveen et al. 2016) by integrating design, content, and demographic complexity within a unified framework, positioning persuasion as the central outcome. Applying the SOR model provides a more holistic and theory-driven lens on DOOH advertising effectiveness, demonstrating how environmental design and consumer-level factors jointly contribute to persuasive effect in retail settings.

Focusing on real-time consumer interactions within South Africa, as an emerging yet underexplored DOOH market, this study generates actionable insights for enhancing campaign design and interaction. These insights demonstrate cross-national relevance, as the interaction between design, content, and demographic complexity reflects universal cognitive and behavioural mechanisms rather than market-specific dynamics.

2. LITERATURE REVIEW

2.1 BOTTOM-UP AND TOP-DOWN PROCESSES IN ADVERTISING

Understanding both bottom-up and top-down processes is equally important in the neural approach to advertising, as it mimics human performance in a way inspired by biological circuitry (Milosavljevic & Cerf 2008). Bottom-up attributes are inherent, noticeable, or salient environmental stimuli that naturally capture attention. In contrast, top-down attributes pertain to goal-directed tasks influenced by consumer demographics, knowledge, expectations, and motivations. Moreover, bottom-up attention operates as a rapid, parallel, pre-attentive process, whereas top-down attention is associated with recognition and analytical processing (Connor et al. 2004; Egeth and Yantis 1997; Pieters & Wedel 2004). Advertisers, therefore, must understand how these two processes not only prompt consumers to notice advertising but also enable them to process and respond to it—insights that are essential for designing effective advertising content and media. In this study, bottom-up and top-down processes are not treated merely as cognitive principles. Still, they are positioned as explanatory mechanisms within an SOR framework, where they function as stimuli that influence perception and persuasion (response) via internal states, such as content experience (organism). Persuasion is not merely a result but the outcome of how stimuli are noticed, processed, and interpreted through both bottom-up and top-down pathways.

In advertising research, neurological and biological measurements are frequently utilised to capture brain activity and consumer behaviour in a non-invasive manner (Braeutigam and Kenning, 2022; Zámečník 2024). Neuroscientific methods are particularly valuable for analysing how consumers experience and process advertising stimuli (Zámečník 2024). For instance, Silberstein and Nield (2008) used steady-state topography (SST), an ERP-based (event-related potential) technique, to estimate brain activity in response to TV advertising stimuli aimed at influencing brand preference. They observed increased activity in the left prefrontal cortex, a region associated with long-term memory, occurring when participants switched to an advertised product. This finding suggests that branding and advertising can activate key brain regions involved in memory and decision-making.

Similarly, Geske and Bellur (2008) examined how individuals comprehend information presented in print versus visual media. They noticed differences in brain processing within the first 100 milliseconds. Visual media elicited

stronger occipital responses, indicating enhanced image recognition and information processing, as well as more efficient activation of brain regions responsible for visual perception and cognitive intake. These findings underscore the capacity of visual advertising stimuli, such as digital signage, to rapidly activate attention and memory systems, stressing the need for DOOH campaigns to optimise both visual salience and message design.

Recent research has examined the impact of digital advertising on the consumer experience. Wooley et al. (2022) utilised Intelligent Bounding Boxes (IBBs) to track viewers' gaze in video content and during screen transitions. Visual features such as size, brightness, and colour captured initial attention, whereas sustained engagement was driven by movement and content relevance. Stable elements were frequently overlooked, as users did not need to remember them. These findings suggest that advertisers should incorporate dynamic elements into DOOH advertising to sustain attention and enhance message comprehension. In this study, such dynamic and salient features are conceptualised under the broader construct of digital signage design.

Bottom-up and top-down processes, along with brain measurements, enhance advertisers' understanding of how consumers perceive and respond to advertising stimuli. Despite these advances, the human brain can process only a limited amount of information—a constraint identified as the attentional bottleneck. As a result, only a fraction of the many marketing messages encountered daily are noticed (Anderson, and Peitz, 2023; Ha and McCann, 2008).

By identifying which content and media features can break through this bottleneck—either by standing out visually (bottom-up) or matching viewer interests (top-down)—advertisers can generate messages that are more likely to capture attention and be retained. This study examines how design and content experiences can help overcome the bottleneck and influence persuasion, particularly across diverse demographic groups. Since interests and interpretations are moulded by cultural, linguistic, and socio-economic backgrounds, incorporating demographic variables is essential for explaining how advertising resonates across heterogeneous audience groups.

2.2 BOTTOM-UP MEDIA ATTRIBUTES OF DIGITAL SIGNAGE

Media owners and advertisers worldwide continue to introduce new digital signage features and immersive experiences. One example is the integration of sensorial and haptic technologies into digital kiosks, delivering physical sensations that enhance multi-sensory engagement. Using ultrasonic transducers, these systems project textures onto users’ hands, enabling interaction without physical contact or external devices. Digital textures can be perceived at distances up to one meter from the display, aided by visual cues and auditory feedback (Oemkiosks 2021; Ultrahaptics 2018).

Other innovations include holographic digital signage, which projects visuals that appear to float, capturing attention through perceptual novelty. These systems may also be integrated with kinetic LED displays that change shape and dimension, enhancing content creativity. Integrating digital signage with metaverse environments enables brands to create hybrid experiences that seamlessly blend physical and virtual realities, which expands opportunities for consumer interaction (OnSign TV 2024). These innovations reflect broader design attributes—motion, interactivity, novelty, and visibility that characterise bottom-up stimuli in DOOH environments.

2.3 DIGITAL SIGNAGE DESIGN

Design elements function as external stimuli (S) that initiate perceptual and affective processing. Earlier research confirms that their effects vary by contextual factors such as screen placement, store type, and traffic levels (Burke 2009; Roggeveen et al. 2016; Wilson & Suh 2018). For instance, Burke (2009) found that consumer responses to store

signage are influenced by screen placement and viewer proximity, whereas Roggeveen et al. (2016) observed stronger effects in large browsing-oriented environments compared to smaller, task-focused retail settings. Wilson and Suh (2018) further demonstrated that digital signage is most effective in high-traffic areas, where visibility and engagement are heightened. However, such findings risk oversimplification by focusing primarily on physical placement while overlooking factors like content relevance. A more comprehensive account requires considering both environmental factors and consumer orientation. Design plays a critical role in persuasion, as it influences whether consumers engage with and evaluate messages. This study builds on these insights by assessing the effectiveness of signage within a real-world, high-density retail environment.

The number of people in a location and their activities can also influence the effectiveness of digital signage. In quieter transport environments, individuals have more time to process stimuli (Wilson & Till 2008). By contrast, crowding does not significantly affect shoppers' responses in retail environments (Wilson & Suh 2018). These findings suggest that environmental and social contexts are more influential than audience density in determining consumer responses to digital signage (Roggeveen et al. 2016; Wilson & Till 2008 2011; Wilson & Suh 2018). Advertisers should therefore consider these environmental dynamics and tailor content according to placements, traffic patterns, and engagement contexts. This study explores these dynamics in a multi-level shopping mall, where shopper movement, crowd flow, and varied signage placement allow for a naturalistic assessment of design effectiveness.

Advertising media experts acknowledge that screen design and features significantly influence the effectiveness of digital signage. For instance, early media research using psychophysiological measures such as heart rate and skin conductance found that larger television and cinema screens elicit higher arousal levels than smaller screens (Reeves et al. 1999). However, viewers of traditional television and film are relatively static compared to consumers in dynamic environments, where multitasking is the norm, such as shopping, commuting, or driving. As these mobile consumers navigate spaces saturated with competing stimuli, visually salient features become essential for capturing and sustaining attention (Wilson et al. 2015; Wilson & Till 2008).

Consequently, the effectiveness of OOH advertising depends on the optimal placement and positioning of digital displays to ensure high-quality exposure (Bhargava et al. 1993; Bhargava and Donthu 1999). Digital signage advertisers should therefore identify and leverage visually salient features such as contrast, motion, size, and brightness to capture immediate attention and sustain it within complex, high-stimulus environments. Therefore, visual salience is obtained through screen quality, visibility, size, location, and design attractiveness.

2.4 DIGITAL SIGNAGE CONTENT EXPERIENCE

Consumer perception of advertising value is a key determinant of effectiveness across both traditional and ambient out-of-home (OOH) media formats, including elevator panels, public fountains, and bus rooftops (Rosengren and Dahlén 2013; Rosengren et al. 2015). Advertising effectiveness is frequently linked to its perceived value, whether informative, emotional, or promotional (Ducoffe 1995)—a principle that equally applies to digital out-of-home (DOOH) media.

In the context of digital signage, content plays a pivotal role in shaping consumer responses. Its impact depends on both the nature of the content displayed and on its alignment with consumer expectations. Given the critical role of content in enhancing audiences' experiences, identifying the most suitable content types for retail environments is essential. In this study, content experience is conceptualised within the ‘Organism’ stage in the SOR model, representing the consumer’s cognitive and affective processing of the displayed message. Content experience is

central to persuasion, as relevance, usefulness, and appeal increase the likelihood of changes in attitude and behavioural intention.

Table 1 summarises empirical findings on how various types of digital signage content influence consumer responses across diverse retail settings, underscoring the importance of content relevance for advertising effectiveness.

Regarding hedonic content, Dennis et al. (2014) suggest that sensory-affective messaging is more effective than purely functional content in enhancing in-store experiences and developing positive consumer attitudes. Roux et al. (2020) similarly found that digital signage in South African upscale malls appeals to shoppers seeking hedonic engagement. However, functional content also plays a meaningful role; it can elevate mood and influence shopping behaviour (Dennis et al. 2010, 2012), increase sales through promotions and information updates (Burke 2009), and outperform general messaging when price-focused (Roggeveen et al. 2016). Overall, the effectiveness of digital signage is context-dependent, requiring alignment with the retail environment and responsiveness to audience needs and moods. The dual value of content, encompassing both experiential and practical aspects, underscores the importance of balancing entertainment with usefulness, depending on the shopper's orientation.

TABLE 1: PAST RESEARCH ON THE INFLUENCE OF DIGITAL SIGNAGE CONTENT IN VARIOUS RETAIL ENVIRONMENTS

Source & Content Types	Type of content investigated & context	Key findings
Hedonic		
Dennis et al. (2014)	Sensory-affective digital signage; Retail stores	Sensory content enhances in-store experience, purchase intent
Roux et al. (2020)	Digital signage in mall environments	Hedonic enjoyment moderates the effect of digital signage on mall approach behaviours.
Utilitarian		
Burke (2009)	News & promotions; Retail stores	Utilitarian content boosts hedonic product sales
Roggeveen et al. (2016)	Price-promotion signage; Retail stores	Relevant, timely signage boosts persuasion, purchase intent
Utilitarian & Hedonic		
Bae et al.(2016)	Digital signage engagement; Retail stores	Consumers use digital signage for convenience, not entertainment
Lee & Cho (2019)	Digital signage advertising, Retail stores	Cognitive and attitudinal factors influence DS ad effectiveness
Roux & Maree (2021)	Digital place-based media; Upmarket shopping malls	Digital place-based media enhances enjoyment and usefulness in malls
Miscellaneous		
Bauer et al. (2011)	Public digital signage; Various locations	Content engagement matters more than design
Nanni & Ordanini (2024)	Automated digital screens; Retail stores	Digital signage screens with automated content improve efficiency but reduce personalisation, lowering impulse purchases and overall spending.

Studies show that combining content types enhances engagement. Bae et al. (2016) found that perceived interactivity motivates consumers through both product information and entertainment. Lee and Cho (2019) recommend merging product details with storytelling, while Roux and Maree (2021) highlight how digital media enhances enjoyment and usefulness in upscale malls. These findings suggest that content type and placement are key to digital signage effectiveness. In this context, content experience refers to consumers' subjective evaluation of the message's usefulness, appeal, and relevance. Hybrid content—blending functional, affective, and interactive dimensions—can optimise engagement, especially in lifestyle-oriented retail spaces.

2.5 THE INTERPLAY BETWEEN DIGITAL SIGNAGE DESIGN AND CONTENT

Research highlights that media features should not be considered in isolation. Design and content interact dynamically to influence consumer engagement and the success of advertising. Baack et al. (2008) and Wilson and Till (2011) found that content alone has a limited impact unless signage is designed to entice, attract, and remain visible within the consumer's field (see also Wilson et al. 2015). These findings align with the SOR model, where content effectiveness (Stimulus) depends on the medium's strength and visibility. Furthermore, experiments in pervasive computing suggest that viewer response to public digital signage relies on both bottom-up effects and contextually relevant content (e.g., Bauer et al. 2011; Müller et al. 2009). This highlights the need to align media design with message relevance to sustain in high-stimulus retail spaces. The persuasiveness of DOOH advertising, especially digital signage, rests on the combined influence of design and content. Persuasion emerges not from design or content alone, but from their interaction in shaping how consumers attend to and evaluate the message.

Drawing from the SOR model, this study tests whether content experience mediates the relationship between signage design and persuasion. In this framework, signage design and content serve as external stimuli, content experience represents internal processing, and persuasion is the response. The SOR model (Mehrabian & Russell, 1974) has been critiqued for assuming that consumers respond passively to stimuli and for treating stimulus situations as objective, overlooking subjective interpretation. The model is also described as linear, implying a unidirectional environment–behaviour relationship. In addition, it has been noted that it assumes emotions are caused primarily by the novelty of stimuli (Vieira, 2013; Scott et al., 2024). However, this model has evolved with appraisal theory, which recognises that consumers actively interpret stimuli, with emotions shaped not only by novelty but also by goal congruity and contextual relevance (Roux et al., 2020; Scott et al., 2024). It is widely applied in retail and media research to explain how environmental signals influence internal evaluations and avoidance behaviours (Roux et al., 2020), and its flexibility supports both bottom-up and top-down processes, making it especially suitable for DOOH advertising.

Accordingly, this study employs the SOR framework as a heuristic rather than a rigid sequence, acknowledging that real-world consumer responses are often nonlinear and context-dependent, and that consumer responses are frequently complex. The contribution of this study is to extend the model by showing that design exerts a direct persuasive effect and that demographic traits further moderate the relationship between design, content, and persuasion. The analysis provides a more detailed application of the SOR model to DOOH advertising, showing that persuasion does not depend solely on content experience but also on design and consumer differences.

Based on the discussion, the following hypotheses are proposed. They are grounded in the literature and supported by arguments developed in the paper: (H1a) Digital signage design significantly predicts persuasion (S → R); (H1b) Digital signage design significantly predicts the digital signage content experience (S → O); (H1c) Content experience positively influences persuasion, mediating the effect of design (O → R).

2.6 TOP-DOWN CHARACTERISTICS AS MODERATORS

Research indicates that advertising content and media factors significantly influence advertising success. However, consumer responses are not uniform; they vary according to individual demographic traits and psychological states (Mehta 2000; Vakratsas & Ambler 1999). Advertisers, therefore, tailor campaigns to meet the specific needs and preferences of distinct consumer segments. Further evidence shows that responses to advertising and media depend on demographic factors such as income level, gender, and language (Chekima 2016; Creusen 2010; Canguende-Valentim and Vale 2022; Leppäniemi and Karjaluoto, 2008; Potgieter & Roux 2024; Roux 2021; Roux 2023). These demographic and cultural characteristics influence how stimuli are perceived, processed, and interpreted, making them

critical moderators of advertising effectiveness. They moderate whether signage and content succeed in persuasion, explaining variation across audience segments. Their inclusion clarifies why specific tactics resonate more with demographically targeted audiences and why effects differ across segments. Accordingly, this study hypothesises that demographic traits moderate the relationships between digital signage design and persuasion (H2a), digital signage design and content experience (H2b), and content experience and persuasion (H2c).

Table 5 presents the study's conceptual framework, which integrates bottom-up and top-down influences, along with the proposed hypotheses, to offer a more nuanced understanding of persuasion in digital signage environments.

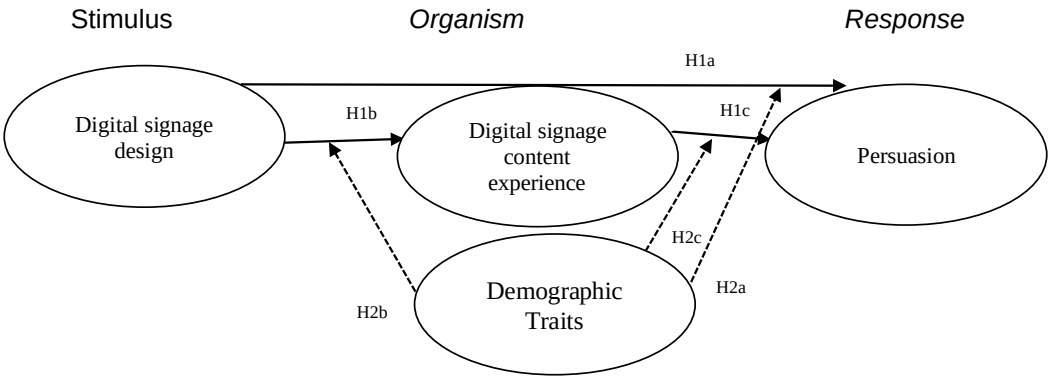

FIGURE 1. CONCEPTUAL MODEL USING THE SOR FRAMEWORK WITH HYPOTHESISED DIRECT AND MODERATING EFFECTS

Source: Created by the author.

3. MATERIALS AND METHODS

This study employed a descriptive design, using surveys to collect data at a large upmarket shopping mall in South Africa. The site was selected for its multi-level layout and diverse mix of retail stores and services, making it well-suited for examining consumer interactions with high-resolution digital signage displays. The mall is equipped by a large out-of-home OOH media owner with interactive touchscreens and LED cylindrical screens, enabling a realistic assessment of digital signage effectiveness in a commercial environment. This setting facilitated the examination of bottom-up attributes (e.g., screen design, content interactivity) and top-down characteristics (e.g., consumer demographics), allowing for analysis of how different consumer segments process and respond to persuasive signage cues. The real-world retail context also enhances ecological validity, as consumer responses were measured under naturalistic exposure conditions. This setup aligns with the SOR model, enabling real-time observation of how external stimuli (signage and content) interact with internal responses (content experience) and are moderated by demographic traits.

A non-probability quota sampling approach was employed to select 350 respondents, ensuring that the sample accurately reflected the typical demographic profile of patrons at upmarket shopping malls. The sample size meets the minimum threshold for mediation and moderation analysis using regression-based techniques, as recommended by established methodological guidelines (Fritz & MacKinnon 2007). Quota sampling was chosen because it allows researchers to obtain a sample that reflects specific characteristics of the target population while maintaining efficiency in data collection (Moser, 2022).

Data were collected after ethical clearance was obtained (TUT Research Ethics Committee, REC2024-06-009). Trained fieldworkers intercepted shoppers near digital signage located in food courts and concourse areas of the mall.

To ensure ecological validity, surveys were conducted on weekdays and weekends, during busy and quiet shopping periods, capturing a range of shopper behaviours. Respondents experienced the medium in a real retail setting, allowing their perceptions to be measured under natural conditions. This approach enabled a more realistic evaluation than methods relying on recall-based or post-exposure impressions.

The structured questionnaire included five-point Likert scales to assess digital signage design (Roux et al. 2020), advertising content experience (Bae et al., 2016), and persuasion (Duffett, 2015), adapted from validated and tested scales. These constructs align with the three main stages of the conceptual model: stimulus (design), organism (content experience), and response (persuasion). To confirm content validity, digital mall signage professionals scrutinised the instrument and verified that it covered all relevant aspects of the selected constructs. This questionnaire was compiled and pilot-tested to evaluate bottom-up attributes, including screen quality, location, visibility, and advertising content experience, encompassing both utilitarian and hedonic components. The pilot survey was conducted with a convenience sample of marketing students studying consumer behaviour to assess clarity, reliability, and potential response biases. Feedback from the pilot study led to minor refinements that enhanced question clarity and measurement consistency of the final questionnaire before full-scale data collection.

Cronbach's alpha was used to assess the reliability of the scales. Mediation analysis following Baron and Kenny's (1986) proposed approach was used to test whether the digital signage content experience mediates the relationship between digital signage design and persuasion (H1). This method was selected for its suitability in testing mediation within simpler model structures.

Compared to structural equation modelling (SEM), the PROCESS macro offers several advantages: it automatically generates a wide range of statistical outputs, reducing the need for advanced coding skills. According to Dastgeer et al. (2020), SEM often requires greater coding proficiency and manual model specification. Hayes, Montoya and Rockwood (2017) further argue that the choice between PROCESS macro and SEM is unlikely to significantly affect study outcomes, as differences in observed variable models are typically small. Given that this study employs a simple mediation model with observed variables, the PROCESS macro represents the most appropriate and efficient analytical approach. Moderation analyses were also conducted to identify which demographic traits moderate the relationships between digital signage design, content experience, and persuasion (H2).

4. RESULTS

The total sample of 350 completed questionnaires included slightly more females (53.3%), with most respondents (40.2%) aged between 25 and 34 years, reflecting the planned quota and the shopper profile of the mall where the data was collected. The majority of the participants spoke an ethnic African language (63.3%), while 36.7% spoke other languages, such as English and Afrikaans, aligning with South Africa's multicultural and multilingual demographics. Consistent with the shopper profile of luxury malls, most respondents (74.2%) fell within the upper-middle (24.9%) to high-income (46.7%) brackets.

When considering the descriptive and reliability statistics in Table 2, the analysis confirmed that all measures used in this study demonstrated satisfactory internal consistency, with Cronbach's alpha scores ranging from 0.76 to 0.89 across the 18 items, each corresponding to a distinct construct. Descriptively, persuasion (M = 4.47, SD = 0.71) and digital signage design (M = 3.91, SD = 1.03) were rated relatively higher than digital signage content experience (M = 3.44, SD = 1.08). The consistently high ratings for signage design suggest that shoppers noticed and appreciated the recently installed interactive digital touchscreens and LED cylindrical screens. Among the design elements, screen

quality (M = 4.15) and attractiveness (M = 3.91) received the highest ratings, while screen size (M = 3.82) and location (M = 3.83) were rated comparatively lower. These patterns reinforce the role of signage design as a key stimulus in the SOR model, driving initial attention and evaluation.

TABLE 2: DESCRIPTIVE AND RELIABILITY STATISTICS

Scale Items	***Alpha***	***Loading***	***Mean***	***SD***
Digital signage design (6 items)	0,89		3,91	1,03
Screen Quality		0,73	4,15	1,00
Attractiveness		0,91	3,91	1,10
Visibility		0,80	3,88	1,07
Design Sophistication		0,83	3,84	1,01
Location		0,72	3,83	1,08
Screen Size		0,69	3,82	0,94
Digital signage content experience (6 items)	0,88		3,44	1,08
Relevant		0,81	3,32	1,08
Useful		0,95	3,54	1,05
Helpful		0,89	3,59	1,02
Striking		0,99	3,42	1,15
Entertaining		0,87	3,37	1,09
Interesting		0,99	3,37	1,11
Persuasion (6 items)	**0,76**		**4,47**	**0,71**
Likely → I'm likely to use products promoted through digital signage.		0,42	4,59	0,63
Trust → I have greater trust in brands that advertise on digital signage.		0,42	4,59	0,63
Buy → I am more likely to buy products advertised on digital signage.		0,53	4,45	0,71
Positive → Digital signage advertisements positively influence my purchasing behaviour.		0,53	4,45	0,71
Desire → Digital signage advertisements make products more appealing to me.		0,58	4,37	0,79
Likeable → Advertisements on digital signage are likeable.		0,58	4,37	0,79

In contrast, the digital signage content experience was rated as less pleasing (M = 3.44, SD = 1.08). While items such as "helpful" (M = 3.59) and "useful" (M = 3.54) performed moderately well; content intended to provide a richer utilitarian and sensory-affective experience—such as "striking" (M = 3.42), "entertaining" (M = 3.37), and "interesting" (M = 3.37) was perceived as less impactful. The inference is that the practical and emotional value of the content did not meet the shoppers' expectations, making the content experience less effective than the persuasive appeal or design features of the signage. Thus, although the content did not strongly engage participants on affective or sensory levels, its role in shaping internal evaluation remains theoretically relevant within the model, as reflected in the non-significant mediation result for H1c.

4.1 HYPOTHESIS RESULTS: BOTTOM-UP MEDIA ATTRIBUTES OF DIGITAL SIGNAGE

The mediation analysis results (Table 3) were interpreted following the four-step approach proposed by Baron and Kenny (1986).

Step 1: Test the Direct Effect (X → Y): Digital signage design has a significant predictive effect on persuasion (β = 0.211, p < 0.001, ***), confirming Hypothesis 1a.

*Step 2: Test the Effect of X on the Mediator (*X → M): Digital signage design strongly predicts digital signage content experience (path a: β = 0.413, p < 0.001,***), confirming Hypothesis 1b.

Step 3: Test the Effect of the Mediator on Y (M → Y, Controlling for X): The effect of digital signage content experience on persuasion (path b: β = 0.102, p = 0.121, n.s.) was not statistically significant. Therefore, the null hypothesis of Hypothesis 1c was not rejected. This result indicates that, while content experience is influenced by signage design, it does not significantly account for additional variance in persuasion when controlling for design.

Step 4: Assess Mediation (Compare c and c'): The direct impact of digital signage design on persuasion remains significant (c': β = 0.169, p = 0.007, **). The indirect effect through digital signage content experience is not substantial (ab = β = 0.042, p = 0.121, p = n.s.). Thus, it can be concluded that the influence of digital signage design on persuasion is primarily direct rather than mediated. This finding supports the notion that external design stimuli can bypass content processing and directly shape response in high-traffic retail environments, consistent with the SOR framework.

TABLE 3. MEDIATION ANALYSIS (H1)

Effect Type & Path	Beta Coefficient	P-value	R^2	Supported
Total Effect (Digital Signage Design > Persuasion)	0.211	**	0.044	Yes
Path a (Digital Signage Design > Digital Signage Content Experience)	0.413	***	0.191	Yes
Path b (Digital Signage Content Experience > Persuasion)	0.102	n.s.	0.071	No
Direct Effect (c' controlling for Digital Signage Content Experience)	0.169	**	0.071	Yes
Indirect Effect (a*b)	0.042	n.s.	NA	No

Note: *** p<.001, ** p<.01, n.s. = not significant

4.2 TOP-DOWN CHARACTERISTICS AS MODERATORS

The moderation analysis in Table 4 indicates that neither age nor home language significantly influences the relationships between constructs. However, gender and income act as moderators. Gender significantly moderates the relationship between digital signage design and persuasion (β = -0.155, p = 0.009) (H2a), with female participants showing a considerably stronger association than males. The results suggest that design features are more persuasive for female consumers. Income also significantly moderates the relationships between digital signage design and persuasion (β = -0.063, p = 0.00) (H2a), with higher-income earners exhibiting a stronger link than lower-income participants. This supports the notion that consumers in higher income brackets are more responsive to design-driven advertising.

Additionally, income also significantly moderates the relationship between digital signage content experience and persuasion (β = -0.021, p = 0.034*) (H2c). Although the negative coefficient indicates a weakening effect as income increases, the relationship remains stronger among high-income respondents, likely due to greater sensitivity to experiential or lifestyle messaging. Overall, the moderation results partially support Hypothesis 2, specifically for gender and income, but not for age or home language.

TABLE 4. MODERATION ANALYSIS (H2)

Relationship	Moderator	Interaction Coefficient	P_value	Significant
Digital signage design → Persuasion (H2a)	Gender	-0,155	**	Yes
	Age	-0,015	n.s	No
	Income	-0,063	***	Yes
	Home language	0,028	n.s	No
Digital signage design → Digital signage content experience (H2b)	Gender	0,011	n.s	No
	Age	-0,009	n.s	No
	Income	-0,033	n.s	No
	Home language	0,031	n.s	No
Digital signage content experience→ Persuasion (H2c)	Gender	-0,087	n.s	No
	Age	-0,006	n.s	No
	Income	-0,021	**	Yes
	Home language	0,012	n.s	No

Note: *** p<.001, ** p<.01, n.s. = not significant

5. DISCUSSION

The purpose of this study was to examine how digital signage design, content experience, and demographic traits influence DOOH persuasion in a retail environment using the SOR framework. By integrating mediation and moderation analyses, the findings provide a more comprehensive understanding of how bottom-up design features and top-down demographic factors jointly influence consumer response. The mediation results show that digital signage design significantly influences persuasion (H1a), consistent with previous research emphasising the importance of high-quality screens, aesthetics, and strategic placement (Waldron 2018; Dennis et al. 2014). Additionally, design strongly predicts content experience (H1b), as reflected in previous studies (Bae et al. 2016; Lee & Cho 2019). Collectively, these results confirm that design serves as the primary driver of both direct persuasion and content processing, positioning it at the core of an effective DOOH strategy.

The moderation findings that content experience does not significantly impact persuasion (H1c) diverge from Roux et al. (2020) but align with Nanni and Ordanini (2024), who found that design outweighs content in influencing consumer response. While content can enhance persuasion, its effectiveness depends heavily on design attributes such as screen quality, visibility, and audience targeting (Burke 2009; Wilson & Till 2011; Roggeveen et al. 2016). Weaker hedonic and utilitarian experiences also limit the impact compared to the stronger sensory implications of design. These findings suggest that content alone cannot drive persuasive outcomes without strong design support. In this setting, content experience was rated lower overall, which may explain its limited influence on persuasion. Another factor may be that design and placement capture attention before content is processed. If the digital signage fails to stand out, consumers may not engage with the message. External distractions, competing visuals, or low consumers' attention may also reduce content effectiveness. Prior studies often used controlled environments, whereas real-world impact depends more on context and consumer intent—highlighting the need to account for environmental and situational variables.

Finally, demographic traits also influenced consumer responses. Income and gender emerged as significant moderators, consistent with global advertising and media research (Chekima 2016; Creusen 2010; Canguende-Valentim and Vale 2022; Leppäniemi and Karjaluoto, 2008). Similar patterns have been observed in African contexts (Canguende-Valentim & Vale, 2022; Potgieter & Roux 2024; Roux 2021; Roux, 2023). These findings underscore the

importance of customising DOOH strategies to specific consumer profiles, particularly within multicultural and segmented retail environments.

Theoretical and Practical Implications

From a theoretical perspective, this study advances the application of the SOR model in DOOH advertising by demonstrating that digital signage design has a direct and significant impact on persuasion. Although the content experience is influenced by design, it did not significantly mediate the relationship between design and persuasion. This research finding challenges previous assumptions that position content as the primary driver of persuasive outcomes. Instead, the results reinforce the importance of design-led stimuli such as screen quality, visibility, and strategic placement in capturing attention and influencing consumer behaviour, especially in high-traffic retail environments.

These insights support a more nuanced view of persuasion in digital signage contexts: content alone is insufficient unless embedded within a compelling and well-designed media format. The findings also highlight that certain demographic traits moderate these effects, suggesting that persuasive strategies should account for message quality and the audience's socio-economic profile.

The following guidelines for advertising media and marketing practitioners, as illustrated in Table 5, translate these findings into actionable strategies for DOOH planning and execution in retail spaces.

TABLE 5: STRATEGIC DESIGN AND IMPLEMENTATION GUIDELINES FOR EFFECTIVE DIGITAL SIGNAGE IN RETAIL

High-Quality Infrastructure	High-resolution screens
	Strategic placement
Hedonic and Entertainment Value	Clear information
	Sensory-affective content
Uniformity and Tailored Design	Consistent design
	Tailored messaging
Bottom-Up Techniques	Movement and Contrast
	Real-time updates
Top-Down Techniques	Ai personalisation
	Contextual relevance
Maximising Consumer Response	Eye-catching designs
	Relevant content

Prioritising High-Quality Digital Infrastructure: Retailers and marketers should invest in high-resolution, strategically positioned digital signage to maximise visibility and consumer engagement. This includes large-format screens in high-traffic zones and high-contrast displays that remain legible under varying lighting conditions.

Enhancing Hedonic and Entertainment Value: Although content experience did not significantly predict persuasion on its own, improving content clarity and emotional appeal remains vital for driving engagement, particularly when paired with strong design elements. Brands and marketers should focus on delivering content that is clear, relevant, useful, engaging, and entertaining. Sensory-affective content should be designed to be more immersive, playful, and

visually striking. Integrating digital signage with mobile apps or loyalty programs can further enrich the experience, creating a seamless and connected consumer drive.

Uniformity and Tailored Design: Advertisers and media owners should maintain consistent design and content across age and language groups to ensure broad appeal. A cohesive design system, featuring uniform layouts, fonts, and brand colours, supports visual consistency and brand recognition. However, since income and gender emerged as key moderators, message framing and media execution should be adapted to enhance relevance for diverse consumer segments. For example, visuals may be aspirational for high-income audiences, emotionally resonant for female viewers, while interactive features can include exclusive quality product displays.

Applying Bottom-Up Techniques to Capture Attention in High-Traffic Areas: Bottom-up techniques leverage attention-grabbing features, such as movement, bright contrasts, and large screens, to engage consumers in busy environments. Advertisers should strategically deploy these visual cues in high-traffic zones such as mall walkways, transportation hubs, and urban streets. Incorporating animations and bold visuals enhances engagement, while signage displaying real-time updates, special offers, and wayfinding information caters to users who prefer passive content consumption.

Applying Top-Down Techniques to Engage Consumers in Controlled Retail Environments: Since design quality significantly influences persuasion in distraction-rich environments, retailers in upscale malls and boutique settings should consider top-down approaches, adapting digital signage to shopper demographics, preferences, and cultural context. AI-driven platforms that adjust content based on time of day, consumer flow, or behavioural patterns can deliver more emotionally resonant messages, deepening engagement and enhancing persuasive impact. These dynamic strategies increase the overall effectiveness and compelling nature of digital signage.

Maximising Consumer Response and Advertising Effectiveness: Advertisers can optimise consumer response by deploying eye-catching designs in high-traffic areas and delivering relevant content that effectively engages viewers. A strategic blend of attention-grabbing visuals and contextually adapted messaging ensures that digital signage remains visible and resonates with targeted audiences.

6. LIMITATIONS AND DIRECTIONS FOR FUTURE RESEARCH

As with most research, this study has specific limitations. First, although data were gathered from shoppers in a real retail context, the study was conducted in a single country (South Africa), which may limit the generalisability of the findings to broader consumer contexts. Additionally, only a few demographic moderators, namely gender, income, age, and home language, were examined. At the same time, other potentially influential factors, such as lifestyle orientation or digital and media literacy, were not considered. The study also focused on immediate responses, excluding long-term consumption and repeated exposure effects. As a result, the findings reflect single-exposure outcomes rather than sustained brand impact or memory.

Future research should explore a broader range of retail environments, including mid-market and budget stores, as well as international markets, to enable cross-cultural and economic comparisons. Additional moderating variables, such as personal values, media literacy, and attention span, should be considered. Experimental designs could be expanded by varying specific design features (e.g., animation, interactivity, screen size) to investigate their effect on content processing. Neuroscience and biometric tools may enrich understanding of the cognitive and emotional mechanisms behind signage impact. Longitudinal studies could offer deeper insights into how consumer behaviour

evolves with repeated signage exposure. Researchers may also examine cultural differences in signage and assess the potential of emerging technologies such as augmented reality (AR) and virtual reality (VR) to enhance effectiveness. Cross-market studies could further test the robustness of the SOR model in culturally diverse DOOH contexts.

7. CONCLUSION

The potential interaction between digital signage design, advertising content experiences, and consumer demographics in driving persuasive effects has been largely overlooked, despite its relevance in consumer behaviour. This study addresses this gap by applying the bottom-up versus top-down processing model—a widely used framework in psychology, neuroscience, and marketing—to explain how individuals perceive and interpret stimuli. Framed within the SOR model, this study conceptualises design and content as external stimuli, content experience as internal evaluation, and persuasion as a behavioural outcome. By examining the relationship between bottom-up attributes (e.g., digital signage media design and advertising content experiences) and top-down factors (e.g., consumer demographics), this research provides practical insights for optimising DOOH advertising. It focuses on emerging markets, such as South Africa, where DOOH advertising is rapidly expanding yet remains underexplored academically. These insights are globally relevant, as universal cognitive and behavioural processes—captured by the bottom-up versus top-down model—explain how signage influences attention and persuasion across diverse contexts.

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